PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 27 September 2001 (27.09.01)	
International application No. PCT/US00/17933	**Applicant's or agent's file reference**
International filing date (day/month/year) 29 June 2000 (29.06.00)	**Priority date** (day/month/year) 29 June 1999 (29.06.99)
Applicant STEFANEK, Ronald, C.	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

26 January 2001 (26.01.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Claudio BORTON
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

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REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

PCT/US 00/17933
International Application No.

29 JUN 2000 (29.06.00)
International Filing Date

PCT INTERNATIONAL APPLICATION RO/US
Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum)

Box No. I TITLE OF INVENTION

HEMMING APPARATUS AND METHOD

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

STEFANEK, Ronald C.
9537 Silica Sand Road
Garrettsville, Ohio 44231
US

[X] This person is also inventor

Telephone No.

Facsimile No.

Teleprinter No.

State *(that is, country)* of nationality: US

State *(that is, country)* of residence: US

This person is applicant for the purposes of: [X] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
[ ] applicant only
[ ] applicant and inventor
[ ] inventor only *(If this check-box is marked, do not fill in below)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

[ ] Further applicants and/or (further) inventors are indicated on a continuation sheet

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: [X] agent [ ] common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

FAGAN, Christopher B.
Fay, Sharpe, Fagan, Minnich & McKee, LLP
1100 Superior Avenue, Suite 700
Cleveland, Ohio 44114-2518
US

Telephone No.
(216) 861-5582

Facsimile No.
(216) 241-1666

Teleprinter No.

[ ] **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

See Notes to the request form

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*

Regional Patent

☒ **AP** **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☒ **EA** **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ **EP** **European Patent:** **AT** Austria, **BE** Belgium, **CH and LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA** **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☒ **AE** United Arab Emirates
☒ **AL** Albania
☒ **AM** Armenia
☒ **AT** Austria
☒ **AU** Australia
☒ **AZ** Azerbaijan
☒ **BA** Bosnia and Herzegovina
☒ **BB** Barbados
☒ **BG** Bulgaria
☒ **BR** Brazil
☒ **BY** Belarus
☒ **CA** Canada
☒ **CH and LI** Switzerland and Liechtenstein
☒ **CN** China
☒ **CR** Costa Rica
☒ **CU** Cuba
☒ **CZ** Czech Republic
☒ **DE** Germany
☒ **DK** Denmark
☒ **DM** Dominica
☒ **EE** Estonia
☒ **ES** Spain
☒ **FI** Finland
☒ **GB** United Kingdom
☒ **GD** Grenada
☒ **GE** Georgia
☒ **GH** Ghana
☒ **GM** Gambia
☒ **HR** Croatia
☒ **HU** Hungary
☒ **ID** Indonesia
☒ **IL** Israel
☒ **IN** India
☒ **IS** Iceland
☒ **JP** Japan
☒ **KE** Kenya
☒ **KG** Kyrgyzstan
☒ **KP** Democratic People's Republic of Korea
☒ **KR** Republic of Korea
☒ **KZ** Kazakhstan
☒ **LC** Saint Lucia
☒ **LK** Sri Lanka
☒ **LR** Liberia
☒ **LS** Lesotho
☒ **LT** Lithuania
☒ **LU** Luxembourg
☒ **LV** Latvia
☒ **MA** Morocco
☒ **MD** Republic of Moldova
☒ **MG** Madagascar
☒ **MK** The former Yugoslav Republic of Macedonia
☒ **MN** Mongolia
☒ **MW** Malawi
☒ **MX** Mexico
☒ **NO** Norway
☒ **NZ** New Zealand
☒ **PL** Poland
☒ **PT** Portugal
☒ **RO** Romania
☒ **RU** Russian Federation
☒ **SD** Sudan
☒ **SE** Sweden
☒ **SG** Singapore
☒ **SI** Slovenia
☒ **SK** Slovakia
☒ **SL** Sierra Leone
☒ **TJ** Tajikistan
☒ **TM** Turkmenistan
☒ **TR** Turkey
☒ **TT** Trinidad and Tobago
☒ **TZ** United Republic of Tanzania
☒ **UA** Ukraine
☒ **UG** Uganda
☒ **US** United States of America
☒ **UZ** Uzbekistan
☒ **VN** Viet Nam
☒ **YU** Yugoslavia
☒ **ZA** South Africa
☒ **ZW** Zimbabwe

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet

☐ .....
☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

PCT/US 00/17933

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day month year)	Number of earlier application	Where earlier application is: national application country	regional application * regional Office	international application: receiving Office
item (1) (29.06.99) 29 JUNE 1999	60/141,434	US		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): (1)

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)* : ISA / US

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority)*: Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets**:

request	:	3
description (excluding sequence listing part)	:	16
claims	:	7
abstract	:	1
drawings	:	6
sequence listing part of description	:	-
Total number of sheets	:	33

This international application is **accompanied** by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract: 6A

Language of filing of the international application: ENGLISH

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Christopher B. Fagan
FAGAN, Christopher B.

[June 29, 2000]
Dated

DELETED BY RO/US

For receiving Office use only (29.06.00)

1. Date of actual receipt of the purported international application: 526 Rec'd PCT/PTO 29 JUN 2000
2. Drawings: ☐ received ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent) ISA / US
6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference SFK 20002PCT	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US00/17933	International filing date *(day/month/year)* 29 JUNE 2000	Priority date *(day/month/year)* 29 JUNE 1999
International Patent Classification (IPC) or national classification and IPC IPC(7): B21D 39/02 and US Cl.: 72/312, 315, 387; 29/243.58		
Applicant STEFANEK, RONALD C.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 0 sheets.

3. This report contains indications relating to the following items:

   I ☒ Basis of the report

   II ☐ Priority

   III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability

   IV ☐ Lack of unity of invention

   V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

   VI ☐ Certain documents cited

   VII ☐ Certain defects in the international application

   VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
26 JANUARY 2001	19 JULY 2002
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer for DANIEL C. CRANE Telephone No. (703) 308-1148

Sheila Veney
Paralegal Specialist
Group 3700

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US00/17933

I. Basis of the report

1. With regard to the elements of the international application:*

[X] the international application as originally filed

[X] the description:
pages 1-16 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the claims:
pages 17-23 , as originally filed
pages NONE , as amended (together with any statement) under Article 19
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the drawings:
pages 1-6 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the sequence listing part of the description:
pages NONE , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

[ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

[ ] the language of publication of the international application (under Rule 48.3(b)).

[ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

[ ] contained in the international application in printed form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] The statement that the information recorded in computer readable form is identical to the writen sequence listing has been furnished.

4. [X] The amendments have resulted in the cancellation of:

[X] the description, pages NONE

[X] the claims, Nos. NONE

[X] the drawings, sheets/~~fig~~ NONE

5. [ ] This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

***Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US00/17933

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. statement

Novelty (N)	Claims	(Please See supplemental sheet)	YES
	Claims	(Please See supplemental sheet)	NO
Inventive Step (IS)	Claims	(Please See supplemental sheet)	YES
	Claims	(Please See supplemental sheet)	NO
Industrial Applicability (IA)	Claims	(Please See supplemental sheet)	YES
	Claims	(Please See supplemental sheet)	NO

2. citations and explanations (Rule 70.7)

Claims 1, 2, 7, 8, 11-14, 18-20, 22 and 28 lack novelty and inventive step under PCT Articles 33(2)and 33(3) as being anticipated and fairly taught by Ito (57-184520). See Figures 3-5 where the hemming apparatus is provided with a steel 20 mounted to the upper body 15 and having a first angled surface 21 and a second angled surface 22, the surfaces being respectively movable between a first operative position and a second operative position.

Claims 1, 2, 7, 8, 11-14, 18-20 and 28 lack novelty and inventive step under PCT Articles 33(2) and 33(3) as being anticipated and fairly taught by Yanagiya (57-124524). See Figures 1(A) and 1(B) where the hemming apparatus is provided with a steel 3 mounted to the upper body 6 and having a first angled surface 3a and a second angled surface 3b, the surfaces being respectively movable between a first operative position and a second operative position.

Claims 11, 15, 16 and 25-28 lack novelty and inventive step under PCT Articles 33(2) and 33(3) as being anticipated and fairly taught by Takatsu (4,346,579). See Figures 6 and 7 where the hemming steel is pivotally connected to the upper body 24 through links 29, 29' and is provided with a prehemming and hemming surfaces so as to bend the panel by movement of the steel through two operative positions. The hemming tool is shown to be angularly movable so as to successively bend the panel into its fully bent condition.

Claims 25 and 26 lack novelty and inventive step under PCT Articles 33(2) and 33(3) as being anticipated and fairly taught by Yanagida (7-88567). See Figure 1 where the hemming tool 4 moves angularly to bend the panel using a prehemming surface and a full hemming surface to successively bend the panel.

Claims 5, 10, 17 and 21 lack an inventive step under PCT Article 33(3) as being obvious over Ito (57-184520). The hemming apparatus is shown by Ito with the exception of using a cam/cam roller arrangement and providing an adhesive between the panels. (Continued on Supplemental Sheet.)

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

V. 1. REASONED STATEMENTS:
The report as to Novelty was positive (YES) with respect to claims 3- 6, 9, 10, 17, 21, 23, 24.
The report as to Novelty was negative (NO) with respect to claims 1, 2, 7, 8, 11-16, 18-20, 22, 25-28.
The report as to Inventive Step was positive (YES) with respect to claims 3, 4, 6, 9, 23, 24.
The report as to Inventive Step was negative (NO) with respect to claims 1, 2, 5, 7, 8, 10-22, 25-28.
The report as to Industrial Applicability was positive (YES) with respect to claims 1-28.
The report as to Industrial Applicability was negative (NO) with respect to claims NONE.

V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):
The use of cam/cam rollers is common in the mechanical arts as a friction reducing feature. It would have been obvious to the skilled artisan familiar with this device to have provided Ito's sliding cam surfaces 18, 19 with rollers so as to reduce the sliding effect between the surfaces as well known in the mechanical arts. The use of adhesive at the hemmed joint of panels is also known in the arts so as to act as a joint seal. It would have been obvious to the skilled artisan at the time of the invention to have modified Ito's panels by further providing an adhesive as well known so as to seal the hemmed joint.

Claims 5, 10, 17 and 21 lack an inventive step under PCT Article 33(3) as being obvious over Yanagiya (57-124524). The hemming apparatus is shown by Yanagiya with the exception of using a cam/cam roller arrangement and providing an adhesive between the panels. The use of cam/cam rollers is common in the mechanical arts as a friction reducing feature. It would have been obvious to the skilled artisan familiar with this device to have provided Yanagiya's sliding cam surfaces 4, 8 with rollers so as to reduce the sliding effect between the surfaces as well known in the mechanical arts. The use of adhesive at the hemmed joint of panels is also known in the arts so as to act as a joint seal. It would have been obvious to the skilled artisan at the time of the invention to have modified Yanagiya's panels by further providing an adhesive as well known so as to seal the hemmed joint.

Claims 5, 10, 17 and 21 have novelty under PCT Article 33(2) because the prior art does not anticipate a hemming tool having a steel mounted to an upper body where the steel is provided with first and second angled surfaces, movable between first and second operative positions, and a cam fixedly secured to the anvil and a cam roller secured to the steel. Further, the hemming tool is not shown to be provided with adhesive for applying between the outer skin and the inner panel.

Claims 3, 4, 6, 9, 23 and 24 have novelty and inventive step by meeting the criteria set out in PCT Articles 33(2)-(3), because the prior art does not teach or fairly suggest a first angled surface of the steel with the same angle as the sloped side of the anvil, a curved recess for the reception of the steel and held against an extended portion of the upper body when the steel is in the first operative position, an indented radius along an intersecting edge of the first and second angled surfaces of the steel and wherein the movement of the steel from the first operative position to a second operative position is complete during a single stroke of the steel in the first direction.

Claims 1-28 meet the criteria set out in PCT Article 33(4) because the invention can be made and used in industry.

---------- NEW CITATIONS ----------
JP 57-184520 A (ITO et al) 13 NOVEMBER 1982, see Figures 3-5.

JP 57-124524 A (YANAGIYA) 03 AUGUST 1982, see Figures 1A, 1B and 2.

US 4,346,579 A (TAKATSU) 31 AUGUST 1982, see Figures 2, 6 and 7.

JP 7-88567 A (YANAGIDA et al) 04 APRIL 1995, see Figures 1 and 2(a)-2(c).

JP 3-184635 A (MIWA) 12 AUGUST 1991, see Figure 1.

JP 2000-343156 A (MIURA) 12 DECEMBER 2000, see Figures 2(A) and 2(B).

JP 2000-288660 A (MIYANAGA et al) 17 OCTOBER 2000, see Figures 4-6.

JP 1-249226 A (HIRABAYASHI) 04 OCTOBER 1989, see Figures 3(A) and 3(B).

US 4,453,396 A (TAKATSU) 12 JUNE 1984, see Figures 6 and 7.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

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4 January 2001 (04.01.2001)

PCT

(10) International Publication Number
WO 01/00918 A2

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(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/141,434 29 June 1999 (29.06.1999) US

(71) Applicant and
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(74) Agent: FAGAN, Christopher, B.; Fay, Sharpe, Fagan, Minnich & McKee, LLP, Suite 700, 1100 Superior Avenue, Cleveland, OH 44114-2518 (US).

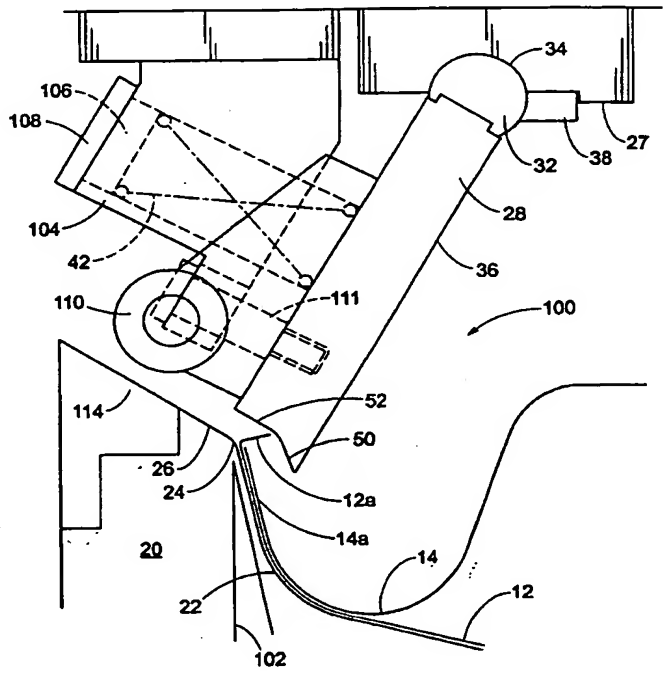
(81) Designated States *(national)*: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *Without international search report and to be republished upon receipt of that report.*

[Continued on next page]

(54) Title: HEMMING APPARATUS AND METHOD



(57) Abstract: In accordance with the present invention, an improved apparatus and method for prehemming and hemming is provided. More particularly, the improved apparatus and method is for folding an edge portion of a curved arcuate panel to create a hem in a single cycle of operation with a single hemming swing steel pressed only in the vertical direction. The apparatus and method use an anvil for supporting an associated assembly of the outer skin and the inner panel, an upper body, and a steel mounted to the upper

[Continued on next page]

WO 01/00918 A2

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

body. The steel is moved between first and second operative positions and has a first angled surface for prehemming the assembly when the steel is in the first operative position and a second angled surface for fullhemming the assembly when the steel is in the second operative position.

HEMMING APPARATUS AND METHOD

This application claims the benefit of and hereby expressly incorporates by reference U.S. Provisional Application Serial No. 60/141,434, filed on June 29, 1999.

Background of the Invention

Field of the Invention

The present invention relates to the hemming arts. More particularly, the present invention relates to improvements in a hemming apparatus and an improved method for hemming sheet metal or like material together. The present invention finds particular application in the automotive field and will be described with particular reference thereto. However, it is to be appreciated that the present invention is also amenable to other like applications.

Discussion of the Art

In the automotive field it is often desirable to join two pieces of sheet metal together in a hemming operation to form a door, hood, trunk deck, or other such component. Generally, a unitary outer skin of sheet metal is hemmed to a second inner reinforcing panel of sheet metal. Hemming involves bending and compressing a generally upturned or perpendicular flange located along each edge of the outer sheet over an adjacent edge of the inner panel. It is important that the hemming results in a firm, vise-like grip of the flanges of the inner panel between the outer panel and its marginal flanges and that

the shape and dimensions of the overall assembly are held within prescribed tolerances.

In the prior art, such hemming has often been accomplished in two separate stages often using two sets of dies mounted in two successive presses. The inner reinforcing panel is nested within the unitary outer panel which is fixtured on an anvil die on a base of a prehemming machine. Upon fixturing the assembly, a tool of the machine, commonly referred to as a hemming steel, engages and bends an edge of the outer panel to an acute included angle with respect to the outer panel. Prehemming is sometimes referred to as "fortyfive-ing" because the angle of the flange becomes about forty-five degrees with respect to the general plane of the outer panel. After prehemming all edges to be joined, both panels are released, transferred to, and fixtured in a second hemming machine where a second steel completely bends the prehemmed edge of the outer panel over the peripheral edge of the reinforcing panel to secure and attach the panels together as a unitary structural member for assembly on a vehicle. This second stage is often referred to as full-hemming.

An obvious disadvantage of the two-stage, two-machine system is the need for two machines which require a significant amount of floor space as well as time and labor resources required for moving the assembly out of one press and into the second press. Because of these disadvantages, the two-stage, two-press system was improved upon and eventually evolved into a single station, two press system where prehemming and full-hemming occur without the need for re-fixturing the assembly between stages. Typically, a plurality of both prehemming and final hemming machines were respectively grouped around the periphery of a panel to perform all prehemming and full-

hemming operations for one assembly either sequentially or substantially simultaneously.

After further improvements, hemming machines were designed to perform both the prehem and final hem operation in a single station, single machine system. Hemming machines of this type vary in the kind of mechanism used and the manner of carrying out the hemming operations.

One group includes machines having linkage driven steels, machines having one rotary steel driven by another linear driven steel, and machines having one steel telescopingly hem from within the prehemming steel. Representative of this group are the following patents: U.S. Patent No. 1,693,643 to D'Ardenne, U.S. Patent No. 5,404,742 to Wilson et al, and U.S. Patent No. 3,903,934 to Vizy.

Another group includes machines having steels that traverse generally linearly in one or two directions. hemming machines of this type, such as U.S. Patent No. 3,143,095 to Tribe, may have a prehemming steel traversing across the general plane of the outer skin and a full-hemming steel traveling perpendicular to the plane of the outer skin. The obvious disadvantage of this type of machine is that it requires two steels or dies, two directions of travel, extra cycle time for two operations, and a substantial amount of space around the assembly which prevents the hemming of internal edges. Alternatively, machines, such as U.S. Patent No. 5,315,855 to Jackson, use a single steel traversing in only the plane of the outer skin have been disclosed but still require a substantial amount of space preventing internal hemming and often result in a hem that is not firm, out of tolerance, and of low visual quality. Finally, there are machines, such as U.S. Patent No. 1,961,582 to Eksergian, that travel only

perpendicular to the general plane of the outer skin but still require substantial space around the assembly, two steels, and do not create a quality hem.

Therefore, it is desirable to provide an improved apparatus and method for hemming sheet material together. The present invention contemplates such an invention that overcomes many of the problems of the prior art and others.

Brief Summary of the Invention

In accordance with the present invention, an improved apparatus and method for prehemming and hemming is provided for minimizing the above-referenced and other disadvantages of the prior art, and in particular, for folding an edge portion of a curved arcuate panel to create a hem in a single cycle of operation with a single hemming swing steel pressed only in the vertical direction.

In accordance with one aspect of the present invention, a hemming apparatus for hemming an outer skin and inner panel together is provided. The apparatus includes an anvil for supporting an associated assembly. The assembly comprising the outer skin and the inner panel. The apparatus additionally includes an upper body and a steel mounted to the upper body. The steel is adapted for movement between first and second operative positions. Furthermore, the steel has a first angled surface for prehemming the assembly when the steel is in the first operative position and a second angled surface for full-hemming the assembly when the steel is in the second operative position.

In accordance with another aspect of the present invention, a method for hemming an outer skin and inner panel together is provided. It includes placing an

assembly on a supporting surface of an anvil. The assembly comprising an inner panel positioned on an outer skin where the inner panel has a peripheral edge and the outer skin has a peripheral flange. It next includes moving a hemming steel, while in a first operative position, in a first direction into the peripheral flange of the outer skin so that an angled prehemming surface of the steel deforms the flange toward the inner panel thereby prehemming the assembly. The hemming steel is further moved in the first direction moving the hemming steel into a second operative position. Meanwhile, the steel moves into the deformed peripheral flange so that a hemming surface of the steel engages the deformed flange and moves it into close contact with the inner panel thereby full-hemming the assembly. Finally, the steel is moved away from the hemmed assembly and removing the finished assembly from the supporting surface.

One advantage of the present invention is the provision of a hemming apparatus that requires only one steel reducing the construction costs of the machine and the maintenance costs of the steel.

Another advantage of the present invention is the provision of a hemming apparatus that substantially reduces the risk of the die "smashing" because the machine will only use one steel to contact the peripheral edge of the assembly.

Another advantage of the present invention is the provision of a hemming apparatus that lacks many complex and moving components.

Another advantage of the present invention is the provision of a hemming apparatus that uses only vertical press motion which prevents compression of the outer, and more visual, skin. Preventing such compression eliminates

or reduces unsightly buckling or waves caused by overruns on the inner skin.

Another advantage of the present invention is the provision of a hemming apparatus that only requires a vertical, mechanical press for operation.

Another advantage of the present invention is the provision of a hemming apparatus that requires only one stroke of a mechanical press to produce a complete hem.

Another advantage of the present invention is the provision of a hemming apparatus that may be used in places such as window openings, gas cap openings, and the like.

Another advantage of the present invention is the provision of a hemming apparatus that substantially reduces the number of weld spots typically required for an entire assembly.

Still further advantages and benefits of the present invention will become apparent to those of ordinary skill in the art upon reading and understanding the following detailed description.

Brief Description of the Drawings

The structure, operation and advantages of the presently preferred embodiment of this invention will become further apparent upon consideration of the following description, taken in conjunction with the accompanying drawings. Of course, the drawings are only for purposes of illustrating preferred embodiments and are not to be construed as limiting the invention.

FIG. 1a is a cross-sectional view of two sheets prior to prehemming and full-hemming in accordance with aspects of the present invention;

FIG. 1b is a cross-sectional view of the two sheets depicted in FIG. 1a after prehemming and before

full-hemming in accordance with aspects of the present invention;

FIG. 1c is a cross-sectional view of the two sheets depicted in FIG. 1a after prehemming and full-hemming in accordance with aspects of the present invention;

FIG. 2 is a diagrammatic view showing a preferred embodiment of a hemming apparatus in accordance with aspects of the present invention;

FIG. 3 is a diagrammatic side view of a prior art two-steel, two-directional hemming apparatus and its related compression forces;

FIG. 4 is a diagrammatic view of the hemming apparatus shown in FIG. 2 and its related compression forces in accordance with aspects of the present invention;

FIG. 5 is a diagrammatic view of an alternate embodiment of a steel in accordance with aspects of the present invention;

FIG. 6a is a diagrammatic view showing an alternate preferred embodiment of a hemming apparatus in accordance with aspects of the present invention;

FIG. 6b is a diagrammatic view of the hemming apparatus shown in FIG. 6a showing the steel in a first position prehemming an assembly; and

FIG. 6c is a diagrammatic view of the hemming apparatus shown in FIG. 6a showing the steel in a second position full-hemming the assembly.

Detailed Description of the Invention

Referring now to the drawings wherein like reference characters represent like elements, the showings

are for purposes of illustrating preferred embodiments of the invention only and not for purposes of limiting the same. The improved hemming apparatus and method described in the description below accurately and speedily carries out an entire prehemming and clinching/full-hemming operation in one cycle and supplies firmly clinched flanges without affecting the dimensional accuracy or the visual appearance of the finished product.

With reference to FIGS. 1a-1c, an assembly is generally indicated by reference numeral **10**. The assembly **10** includes two elements of pressed sheet metal or other suitable material respectively constituting the unitary outer skin **12** and the inner reinforcing panel **14** of a motor vehicle assembly. The assembly **10** may be, without limitation, a motor vehicle door, hood, trunk deck or other component. The assembly **10** rests on a fixed supporting structure or anvil **16**. The anvil **16** has a horizontal supporting surface **18** for positioning and supporting the outer skin **12** and the inner panel **14**.

FIGS. 1a-1c depict the sequential movement and resulting position of the assembly **10** during a hemming operation. With specific reference to FIG. 1a, the outer skin **12** and the inner panel **14** are shown at rest prior to the hemming operation. The underlying outer skin **12** has a peripheral flange **12a** arranged substantially at ninety degrees with respect to the anvil supporting surface **18** and is offset slightly from distal end of the peripheral edge **14a** of the overlying inner panel **14** as is well known.

With specific reference to FIG. 1b, the outer skin **12** and the inner panel **14** are shown after the first step or prehemming step of the hemming operation. In this step, the peripheral flange **12a** of the outer skin **12** is

bent forty-five degrees relative to its starting position in the direction of the inner panel **14**.

With specific reference to FIG. 1c, the outer skin **12** and the inner panel **14** are shown after the clinching or full-hemming step. In this step, the peripheral flange **12a** of the outer skin **12** is bent further and now is arranged at about ninety degrees relative to its initial position. The peripheral flange **12a** is superimposed and pressed against the peripheral edge **14a** creating a joint between the outer skin **12** and the inner panel **14**. Many such joints may exist on a single assembly **10** and are generally located about the periphery edges of the outer skin **12** and the inner panel **14**. Joints may even be located at interior locations on the assembly **10** such as a window or gas cap recess.

With reference to FIG. 2, a hemming apparatus **15** includes a lower body or anvil **20** having a major supporting surface **22** for supporting the unitary outer skin **12** and the inner reinforcing panel **14**. The inner panel **14** is positioned on the outer skin **12** with its edge **14a** slightly offset from the peripheral flange **12a**. The flange **12a** is arranged substantially at ninety degrees with respect to the anvil supporting surface **22**. The peripheral flange **12a** on the outer skin **12** rests directly along one edge **24** of the anvil **20**. The same edge **24** of the anvil **20** is adjacent to a sloping side **26**, angled at forty-five degrees in the preferred embodiment of the invention.

The hemming apparatus **15** additionally includes an upper body **27** as either a connected or separate component. The upper body **27** is mounted to a vertical press (not shown) as is well known. The upper body **27** holds the swing

tool or steel 28 formed in accordance with the present invention by means of a screw 30 or the like. Steel 28 is constructed of a suitable material with an appropriate hardness as is well known. The steel 28 has a round or rounded upper surface 32 which nestles inside a curved recess 34 of the upper body 27 such that the steel 28 may pivot outward from the upper body 27. An inner side 36 of the steel 28 rests against the keeper or extended portion 38 of the upper body 27. The outer or exposed side 40 is open and held in place by a spring 42 or other biasing means. The spring 42 is a blue medium duty die spring with a strength of 216 lbs. in the preferred embodiment. Of course, other suitable springs may be used.

The bottom surface of the steel 28 has two angled surfaces 50 and 52 defined at angles α and β, respectively. Angles α and β are relative to respective planes positioned parallel to the supporting surface 22. The prehemming angled surface 52, extends from the bottom open edge 44 of the steel 28 inward and upward to the approximate center 46 of the steel 28 at an angle α which is equal to that of the sloped side 26 of the anvil 20. Full-hemming angled surface 50 extends from the closed, bottom edge 48 of the steel 28 inward and downward at angle β to the approximate center 46 of the steel 28 meeting prehemming angled surface 52. The magnitude of angle β is such that when the steel 28 is forced vertically downward to its farthest position at which point the steel 28 is pivoting against the spring 42, angled surface 50 will rest parallel to the supporting surface 22 of the anvil 20.

In operation, the upper body 27 moves the steel 28 downward in a first operative position to contact the

peripheral flange 12a of the outer skin 12 and the sloping side 26 of the anvil 20. The upper body 27 is powered by a vertical press as is well known but other suitable driving means may be employed. When the steel 28 first contacts the peripheral flange 12a, the flange 12a will bend inward toward the inner panel 14 until the prehemming angled surface 52 of the steel 28 contacts the sloping side 26 of the anvil 20. At this point, the steel is still in the first operative position and the bend in the peripheral flange 12a is at angle α relative to the supporting surface 22 of the anvil 20. Thus, the prehemming of the peripheral flange 12a to the inner panel 14 is complete.

As the upper body 27 continues to move the steel 28 downward, i.e., toward the anvil support surface 22 and a second operative position, the steel 28 is forced to pivot from the upper body 27 at the screw 30 against the force of the spring 42 owing to the prehemming surface 52 of the steel 28 slidably engaging the sloping side 26 of the anvil 20. The stiffness of the spring 42 is such that steel 28 is generally secured against upper body 27, including during the prehemming operation, but gives appropriately when the steel 28 is forced to pivot against sloping side 26 of the anvil 20. The steel 28 will continue pivoting and moving downward until the full-hemming angled surface 50 is substantially parallel to the supporting surface 22 of the anvil 20. At this point, the steel is in the second operative position and the peripheral flange 12a of the outer panel 12 and the inner panel 14 are completely hemmed.

In a preferred embodiment, the peripheral flange 12a will be arranged at about ninety degrees with respect

to its initial position so that it is superimposed and pressed against the peripheral edge **14a**. The upper body **27** is then retracted upwards, moving the steel **28** upward and away from the hemmed outer skin **12** and inner panel **14**. Of course, the spring **42** or other biasing means moves the steel **28** to its home or first operative position illustrated in FIG. 2. The outer skin **12** and inner panel **14** together form a complete hemmed assembly **10** which may now be removed from the anvil **20**. Thus, the apparatus **15** will have only used one cycle of a vertical press to complete both the prehemming and full-hemming operations. Several steels **28** may be employed simultaneously and powered by a single vertical press. In such an arrangement, several hems are completed upon one stroke of the vertical press.

An important aspect of the present invention relates to its ability to substantially reduce undesirable compression forces typically exerted on the peripheral flange **12a** in prior art hemming machines. Referring to FIG. 3, previously known devices often use a two-steel, two-stage process or other similar process to hem the outer skin **12** to the inner panel **14**. Prehemming is accomplished when a horizontal steel **54** moves toward the assembly **10** and engages the peripheral flange **12a**. Horizontal steel **54** continues and forces peripheral flange **12a** to bend inward toward supporting surface **22** of the anvil **20** until horizontal steel surface **54a** meets sloping surface **26**.

Such a prehemming process is problematic because horizontal steel **54** begins forcing peripheral flange **12a** to bend against the peripheral edge **14a**. Thus, the skin **12** exerts a force on the panel **14** during the bending. Between the force of horizontal steel **54** and the immobile

resistance of anvil 20, this force causes either the outer skin 12 or the inner panel 14 to buckle producing an undesirable and rough finish. The vertical steel 56 completes the hem by full-hemming the peripheral flange 12a to the peripheral edge 14a but the unsightly buckle remains in the outer skin 12 or the inner panel 14.

Referring to FIG. 4, the present invention uses only vertical motion to complete the hemming operation in contrast to the prior art. The upper body 27 moves the steel 28 downward toward the peripheral flange 12a. When the tool 28 engages the peripheral flange 12a and begins bending the peripheral flange 12a inward and downward toward the supporting surface 22 of the anvil 20, the force C applied to the peripheral flange 12a is substantially downward. The buckling problem of the prior art is absent because the peripheral flange 12a is allowed to move out toward the slope side 26 of the anvil 20. Thus, the finished hem has a desirable finish without any unsightly buckles.

Optionally, an adhesive may be applied to the peripheral flange 12a of the outer skin 12 and to the peripheral edge 14a of the inner panel 14 prior to hemming to enhance the integrity of the hem. The adhesive seals and firms the hem and enhances some or all of the advantages of the present invention.

Alternately, with additional reference to FIG. 5, the steel 28 may include an indented radius 60 located along the intersecting edge between the full-hemming angled surface 50 and prehemming angled surface 52. The radius 60 provides clearance between the steel 28 and the assembly 10 during the movement of the steel 28 from the first operative position where prehemming occurs and the second

operative position where full-hemming occurs. Such clearance decreases the likelihood of the steel 28 damaging the peripheral flange 12a and edge 14a during the transition between the two positions.

With reference to FIGS. 6a-6c, a hemming apparatus 100 is shown according to an alternate preferred embodiment of the present invention. The apparatus 100 includes an anvil 20 having a major supporting surface 22 for supporting the unitary outer skin 12 and the inner reinforcing panel 14. The supporting surface 22 is angled approximately twelve degrees relative to the vertical face 102 of the anvil 20. The outer skin 12 rests on the supporting surface 22 with the inner panel 14 positioned on the outer skin 12. The outer skin 12 includes a peripheral flange 12a which extends away from and perpendicular to the supporting surface 22. The peripheral flange 12a is positioned at or near one edge 24 of the anvil 20. Adjacent the supporting surface 22 is a sloping side 26 which extends at a forty-five degree angle relative to the supporting surface 22.

The hemming apparatus 100 includes an upper body 27. The upper body 27 is mounted to vertical press by means of a die shoe and a machine steel sub plate as is well known. The upper body 27 holds a steel 28 formed in accordance with the present invention. The steel 28 has a rounded upper surface 32 which nestles inside a curved recess 34 of the upper body 27. An inner side 36 of the steel 28 rests against an extended portion 38 of the upper body 27.

The apparatus 100 additionally includes a spring housing 104 that encloses a medium or heavy duty die spring

42. The housing 104 is adapted to receive a preload spacer 106 at a distal end of the spring 42 and includes a spring cap 108 for forcing the spring 42 against the steel 28. The preload spacer 106 may vary and serves the purpose of allowing for variable adjustment of the resistance of the spring 42. A plurality of roller bearings 110 are also provided and secured to the steel 28 by a connecting means 111. Roller bearings 110 engage a cam 114 mounted to the anvil 20 upon actuation and movement of the vertical press toward the anvil 20 so that roller bearings 110 travel on the cam 114 and move the steel 28 into its second operative position. The steel 28 is shown in a first position prior to actuation and movement by the vertical press.

Similar to the first preferred embodiment, the steel 28 has two angled surfaces, a prehemming surface 52 and a full-hemming surface 50. The respective angles of the surfaces 50 and 52 are calculated as described above. The prehemming surface 52 is at an angle approximately equal to that of the sloping side 26 and the hemming surface 50 is at an angle adapted to provide a full hem upon pivotal movement of the steel 28.

In operation, the upper body 27, powered by the vertical press, moves the steel 28 toward the peripheral flange 12a of the outer skin 12. The steel 28 is initially in a first or resting position, i.e., the steel 28 is urged against the extended portion 38 by the spring 42. The steel 28 will contact and bend the peripheral flange 12a inward toward the inner panel 14 until the roller bearings 110 engage the cam 114. With reference to FIG. 6b, the bend in the peripheral flange 12a is at an angle approximately equal to the sloping side 26 of the anvil 20

and the roller bearings 110 are fully engaged with the cam 114. Thus, the prehemming of the peripheral flange 12a is complete. At this point, the engagement between the roller bearings 110 and the cam 114 prevent the prehemming surface 52 of the steel 28 from moving any further into the peripheral flange.

Further movement by the vertical press forces the steel 28 to pivot against the spring 42. The roller bearings 110 move along the cam 114 and the steel 28 pivots from a first position to a second position. During the transition from the first position to the second position, the full-hemming surface 50 of the steel 28 engages and moves the peripheral flange 12a of the outer skin 12. The full-hemming surface 50 continues to bend the peripheral flange 12a toward the inner panel 14 until the flange 12a is superimposed and pressed against the peripheral edge 14a of the inner panel 14. At this point the steel 28 is in its second operative position and the assembly is fully hemmed (FIG. 6c). As in a previous embodiment, the vertical press may be reversed to remove the steel 28 from the hemmed assembly 10 and the hemmed assembly 10 may be removed.

The invention has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

Having thus described the preferred embodiments, the invention is now claimed to be:

1. A hemming apparatus for hemming an outer skin and inner panel together, the apparatus comprising:

an anvil for supporting an associated assembly comprising an outer skin and an inner panel;

an upper body; and

a steel mounted to the upper body for movement between first and second operative positions, the steel having a first angled surface for prehemming the assembly when the steel is in the first operative position and a second angled surface for full-hemming the assembly when the steel is in the second operative position.

2. The apparatus of claim 1 wherein the anvil has a horizontal supporting surface and a sloped side for contacting and moving the steel from the first operative position to the second operative position.

3. The apparatus of claim 2 wherein the first angled surface of the steel is defined at substantially the same angle as the sloped side of the anvil.

4. The apparatus of claim 3 wherein the second angled surface of the steel is defined to lie parallel to the horizontal supporting surface of the anvil when the steel is in its second operative position.

5. The apparatus of claim 1 further comprising:

a cam fixedly secured adjacent the anvil; and

a cam roller operatively secured to the steel, the cam roller engaging the cam and moving the steel from

the first operative position to the second operative position when the steel is moved adjacent the anvil.

6. The apparatus of claim 1 wherein the steel is mounted within a curved recess of the upper body and held against an extended portion of the upper body when the steel is in the first operative position.

7. The apparatus of claim 1 further comprising:

a bias means for urging the steel to the first operative position.

8. The apparatus of claim 7 wherein the bias means is a spring.

9. The apparatus of claim 1 wherein the steel includes an indented radius along an intersecting edge of the first and second angled surfaces, the radius providing clearance between the steel and the assembly when the steel transitions from the first to the second operative position.

10. The apparatus of claim 1 wherein an adhesive is applied between the outer skin and the inner panel for enhancing the integrity of the hem.

11. A hemming apparatus for hemming panels together, the apparatus comprising:

an anvil including a support surface adapted for supporting an assembly that includes first and second adjacent panels to be hemmed, the first panel including a peripheral flange projecting away from the anvil support surface and the second panel including a peripheral edge

place adjacent the flange;

an upper body, at least one of said anvil and said upper body movable toward the other;

a hemming steel connected to the upper body and adapted for movement between first and second operative positions, the hemming steel defining a prehemming surface and a hemming surface angled at respective first and second angles relative to the anvil support surface whereby, upon movement of the upper body and the anvil together, the prehemming steel surface contacts and deforms the flange, and upon continued movement of the upper body and anvil together the steel moves to the second operative position so that the second, full-hemming surface engages the deformed flange and moves the deformed flange into close abutment with the second panel.

12. The apparatus of claim 11 further comprising:

a bias means for urging the steel to the first operative position.

13. The apparatus of claim 12 wherein the bias means is a spring.

14. The apparatus of claim 11 wherein the anvil includes a sloped surface adjacent the support surface for contacting and moving the steel from the first operative position to the second operative position when the anvil and the upper body move together.

15. The apparatus of claim 11 wherein the steel is pivotally connected to the upper body and adapted to pivot between the first and second operative positions.

16. The apparatus of claim 15 wherein the steel is forced to pivot from the first position to the second position when the steel engages the sloped surface of the anvil.

17. The apparatus of claim 11 wherein an adhesive is applied between the peripheral flange and the peripheral edge prior to full-hemming.

18. A method for hemming an outer skin and inner panel together, the method comprising the steps of:

placing an assembly on a supporting surface of an anvil, the assembly comprising an inner panel positioned on an outer skin, the inner panel having a peripheral edge and the outer skin having a peripheral flange;

moving a hemming steel, while in a first operative position, in a first direction into the peripheral flange of the outer skin so that an angled prehemming surface of the steel deforms the flange toward the inner panel thereby prehemming the assembly;

moving the hemming steel to a second operative position and moving the hemming steel further in the first direction into the deformed peripheral flange so that a hemming surface of the steel engages the deformed flange and moves it into close contact with the inner panel thereby full-hemming the assembly.

moving the steel away from the hemmed assembly; and

removing the finished assembly from the supporting surface.

19. The method of claim 18 wherein the peripheral flange of the outer panel is upstanding and the

peripheral edge of the inner panel is flat, both relative to the supporting surface and prior to any contact by the steel.

20. The method of claim 18 wherein the anvil includes a sloped surface for engaging the steel and causing the steel to move from the first operative position to the second operative position when the steel is moved in the first direction after prehemming.

21. The method of claim 18 further comprising:

applying an adhesive to at least one of the inner panel and the outer skin the region of the peripheral edge and the peripheral flange, respectively.

22. The method of claim 20 wherein the prehemming occurs substantially simultaneously with the steel engaging the sloped side of the anvil.

23. The method of claim 18 wherein movement of the steel from the first operative position to a second operative position is completed during a single stroke of the steel in the first direction.

24. The method of claim 23 wherein the single stroke is continuous and uninterrupted.

25. A hemming method comprising:

providing a first sheet metal panel including a first surface and an upturned flange that projects outwardly away from the first surface;

placing a second surface of a second sheet metal panel in abutment with the first surface, with an edge of

the second sheet metal panel adjacent the upturned flange, the first and second sheet metal panels together defining a sheet metal assembly;

supporting the assembly on a support surface;

providing a hemming tool with a prehemming surface inclined at a first angle relative to the support surface and a full-hemming surface inclined at a second angle relative the support surface;

moving the hemming tool in a first direction to a prehemming location so that the prehemming surface of the tool contacts and deforms the flange toward the first and second sheet metal panels;

moving the hemming tool angularly relative to the support surface so that the full-hemming surface of the hemming tool is operatively positioned relative to the deformed flange; and

moving the hemming tool from the prehemming location further in the first direction to a full-hemming position so that the full-hemming surface of the hemming tool contacts and moves the deformed flange into close abutment and wrapping engagement with the second sheet metal panel.

26. The hemming method of claim 25 wherein the steps of moving the hemming tool in the first direction to the prehemming location and moving the hemming tool in the first direction to a full-hemming location are effected by a single movement of the hemming tool in the first direction.

27. The hemming method of claim 25 wherein the step of moving the hemming tool angularly results from the step of moving the hemming tool in the first direction from

the prehemming location to the full-hemming location when the hemming tool contacts and engages at least one of the support surface and a fixed member adjacent the support surface.

28. A method for hemming an outer skin and inner panel of a motor vehicle assembly together, the method comprising the steps of:

placing an assembly on a supporting surface of an anvil, the assembly comprising an inner panel positioned on the an outer skin, the inner panel having a peripheral edge and the outer skin having a peripheral flange;

moving a steel in a single stroke into the peripheral flange of the outer skin and the peripheral edge of the inner panel thereby hemming the assembly, the steel having a first angled surface for effecting a prehem and a second angled surface for effecting a full-hem, wherein the steel moves from a first prehem position to a second full-hem position during the single stroke to align the first and second angled surfaces with the assembly sequentially;

removing the steel from the hemmed assembly; and

removing the finished assembly from the supporting surface.

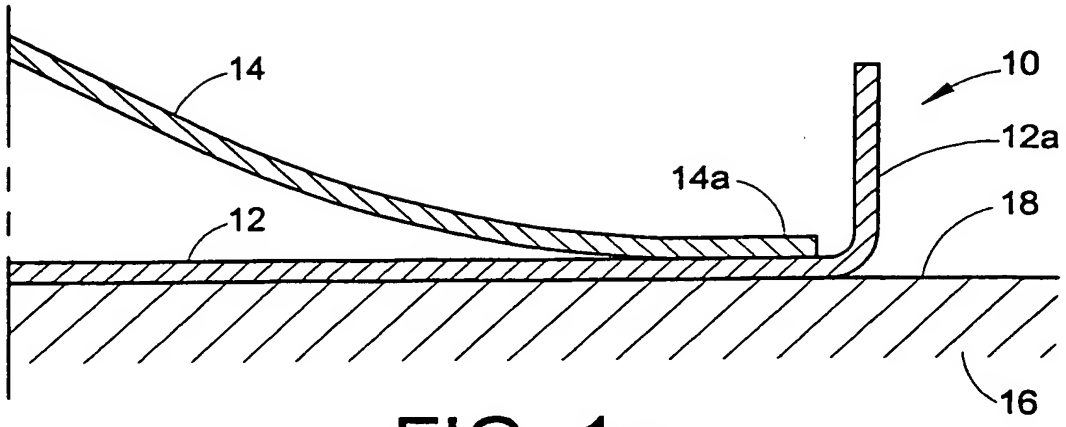


FIG. 1a

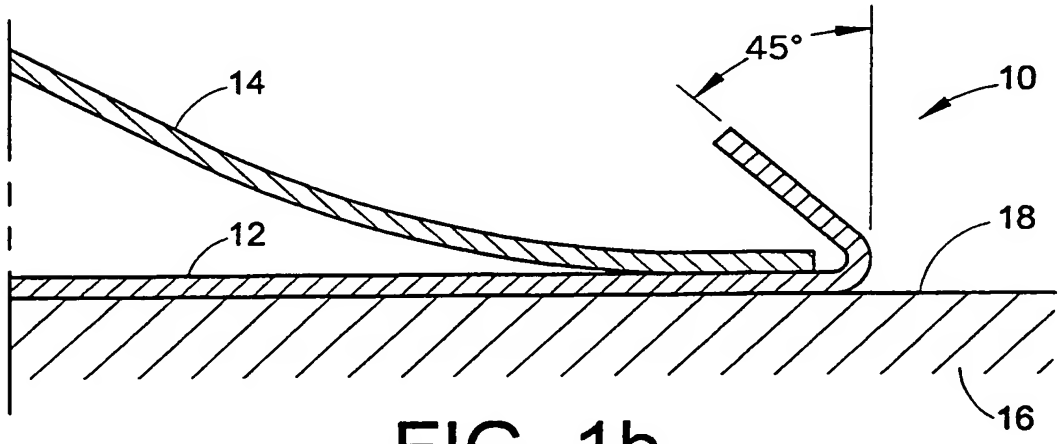


FIG. 1b

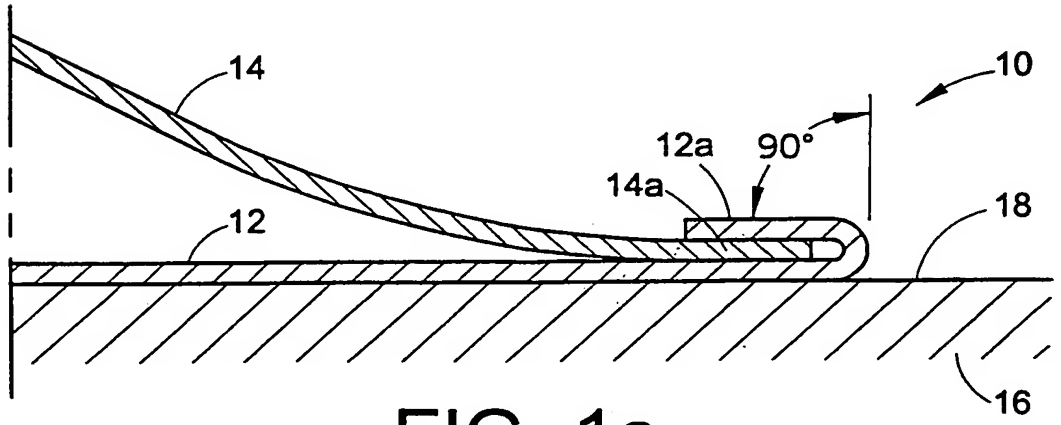
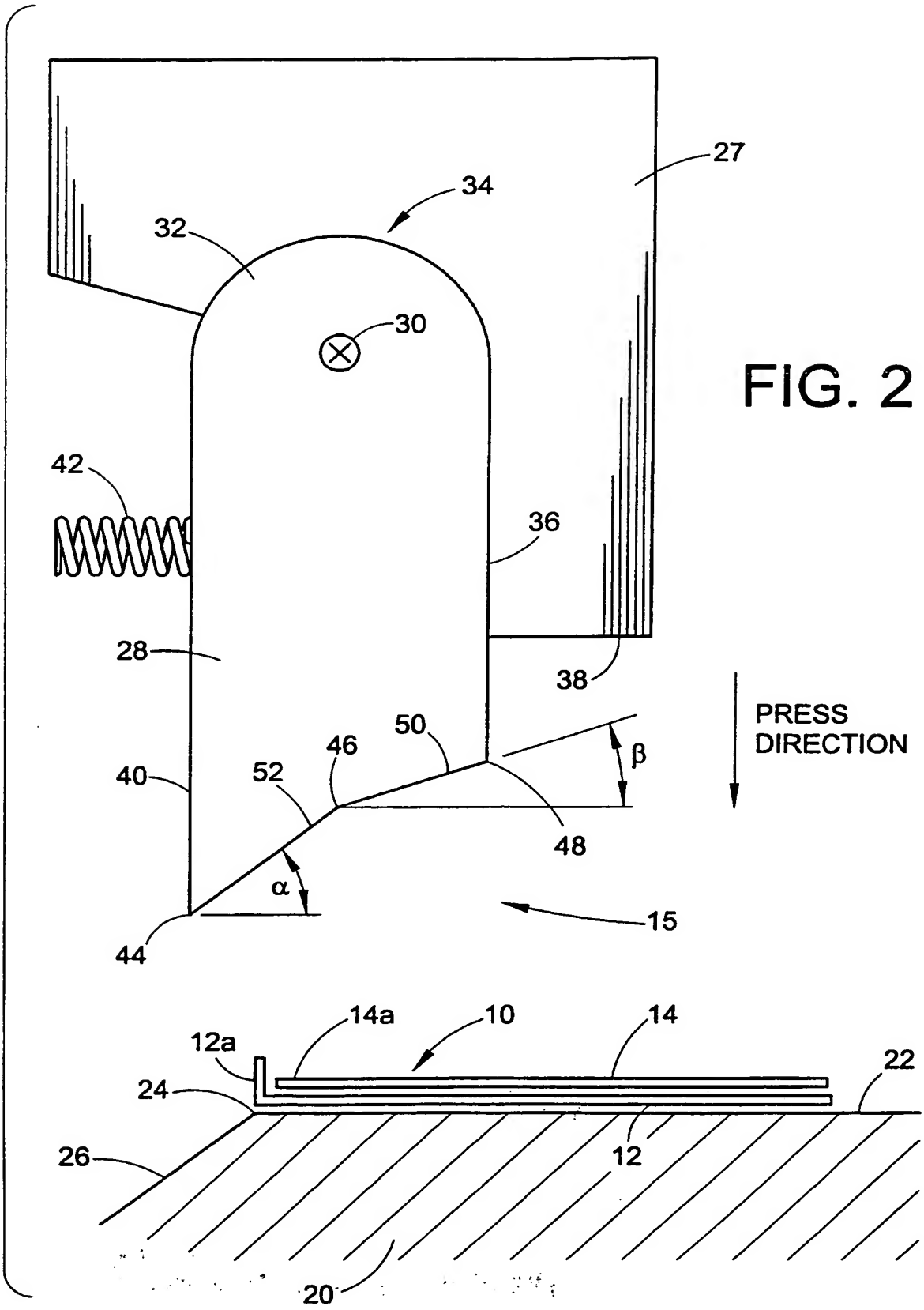


FIG. 1c


27
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14a
10
14
12a
22
24
26
12
20

FIG. 2

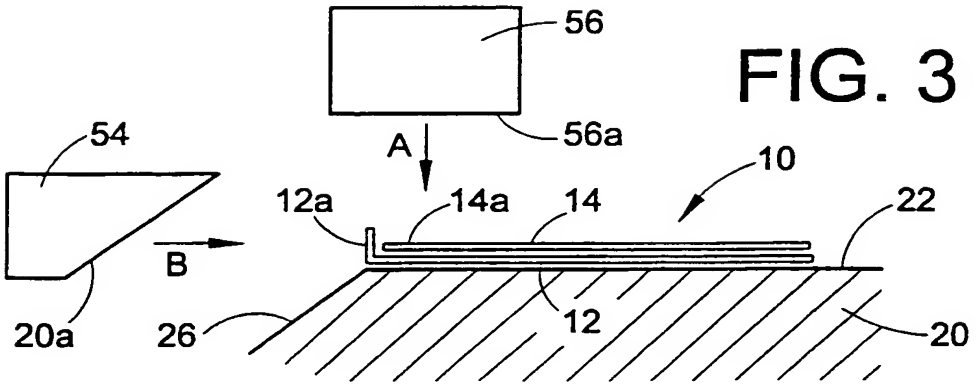


FIG. 3

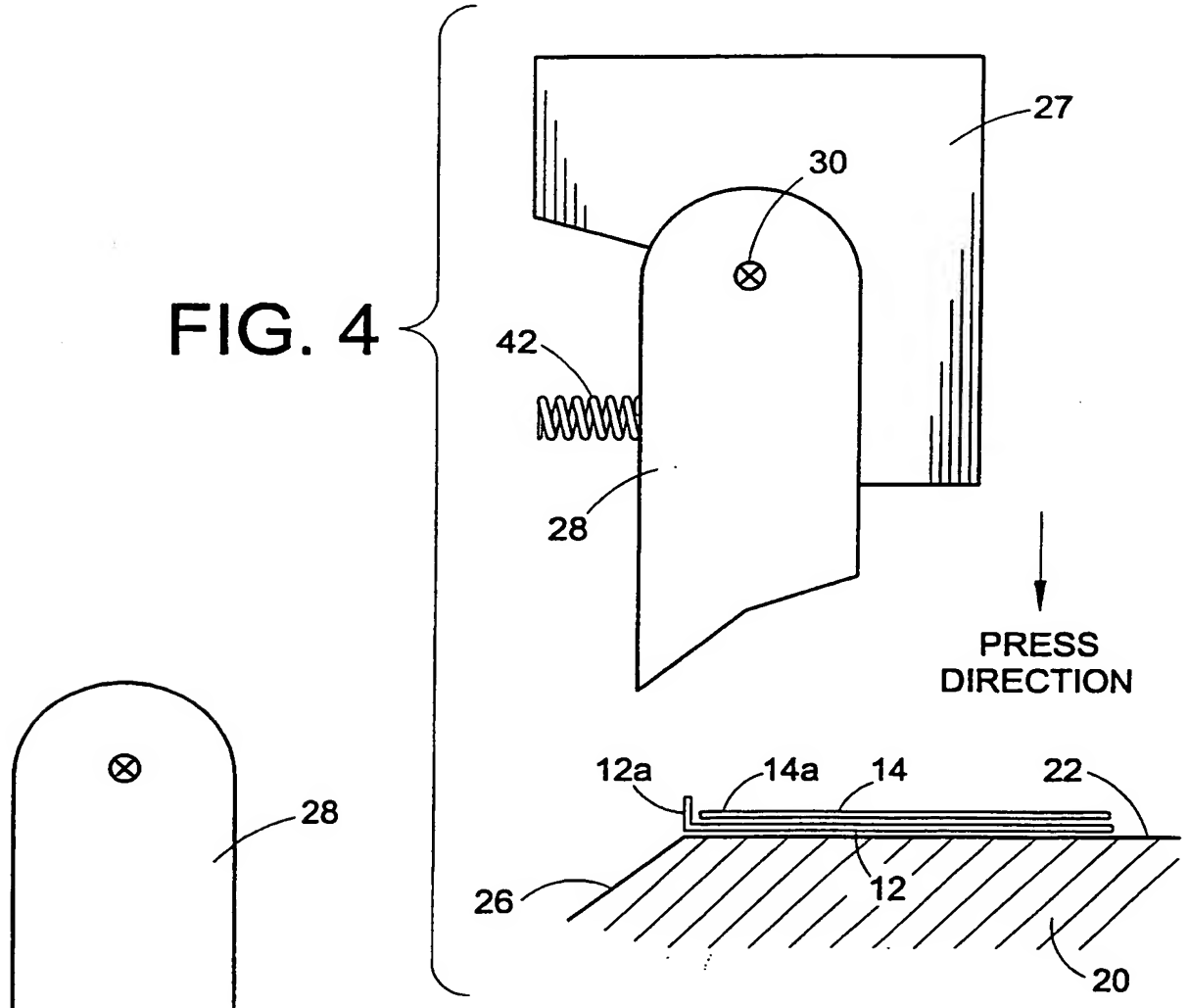


FIG. 4

FIG. 5

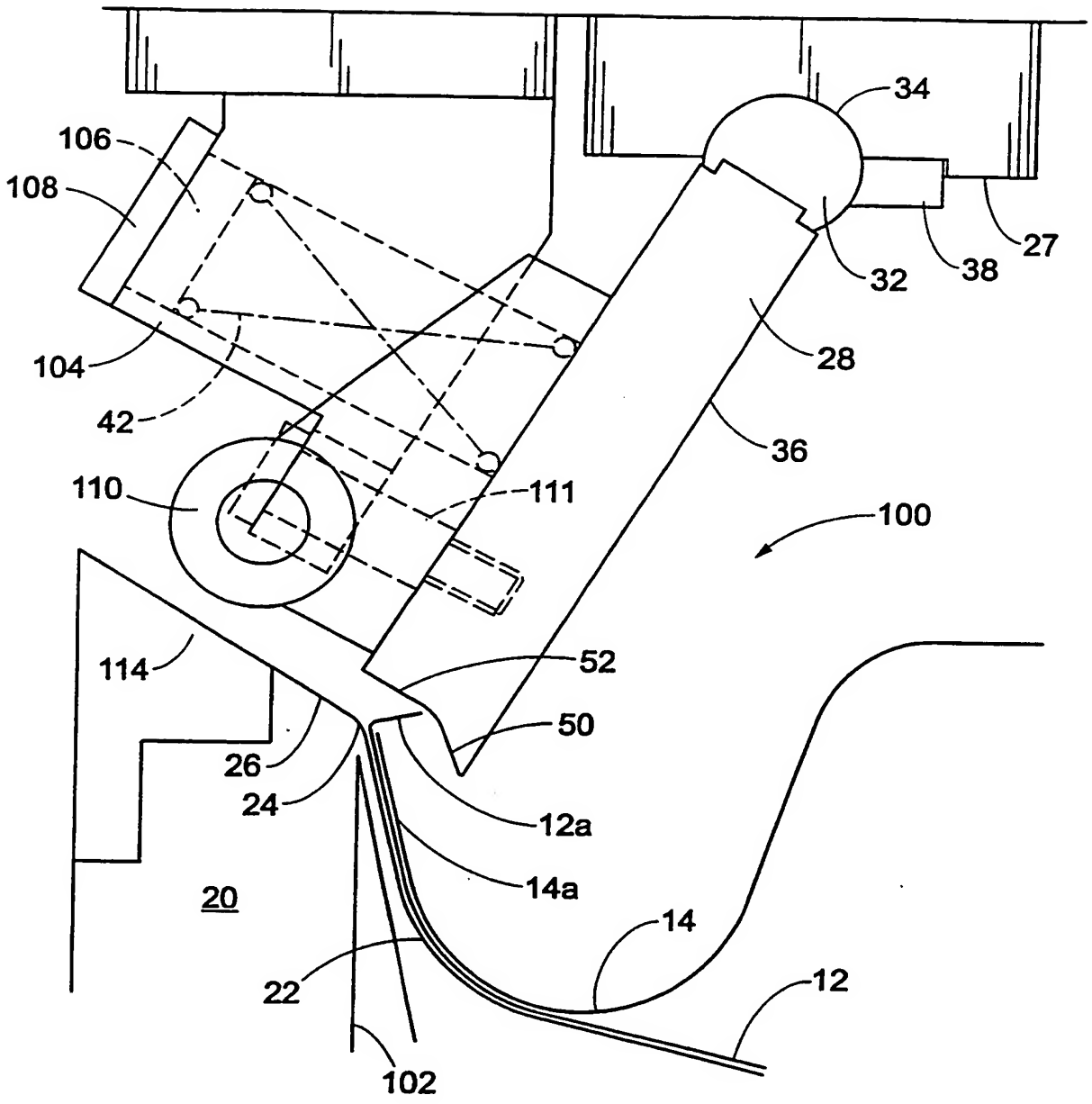
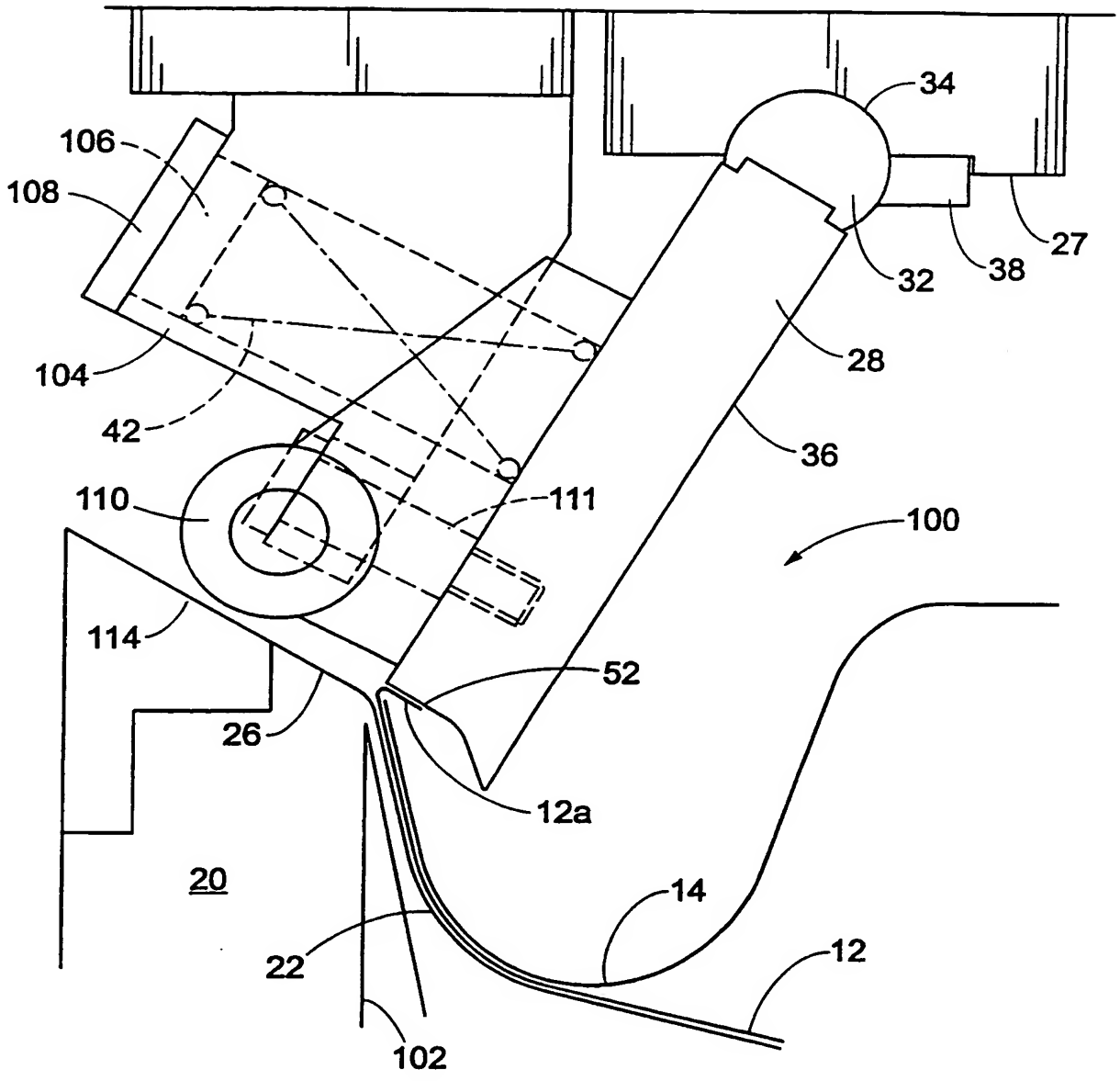

34
106
108
27
32
38
104
28
42
36
110
111
100
114
52
50
26
24
12a
14a
20
14
22
12
102

FIG. 6a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12a
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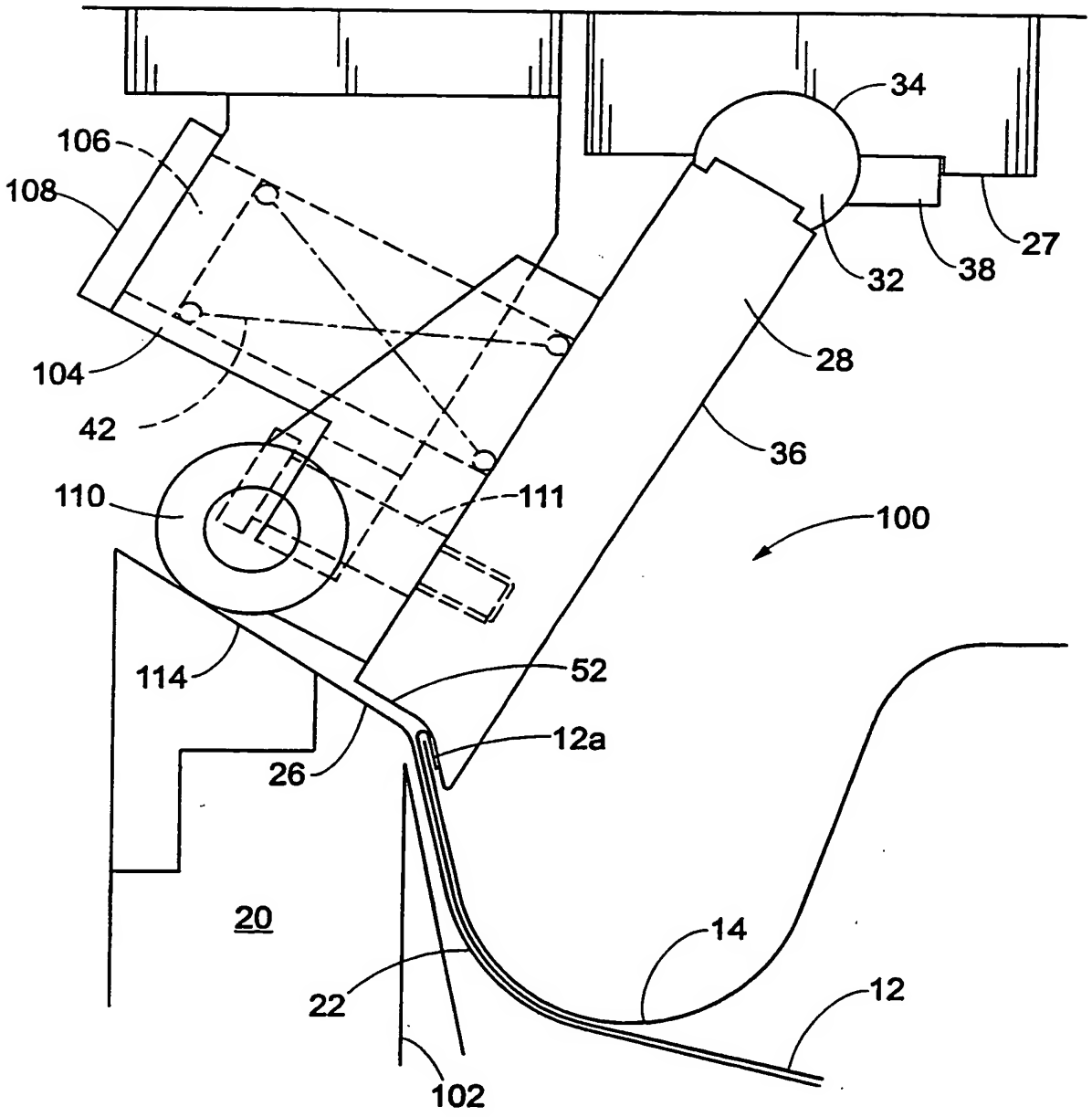
12
102

FIG. 6b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102

FIG. 6c